

CHAPTER 1

WATER QUALITY ASSESSMENT OF RIVERS AND STREAMS

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Surface Water Monitoring Program

An effective water monitoring program is essential for making sound pollution control decisions and for tracking water quality improvements. Specifically, the Division of Water's (DOW) ambient monitoring program provides data to identify priority waterbodies upon which to concentrate agency activities, to revise state water quality standards, to aid in the development of wasteload allocations, and to determine water quality trends in Kentucky surface waters. As outlined in the Kentucky Ambient Surface Water Monitoring Strategy (DOW, 1986), the major objectives associated with the Ambient Monitoring Program are:

1. To operate a fixed-station monitoring network meeting chemical, physical, and biological data requirements of the state program and EPA's Basic Water Monitoring Program (BWMP).
2. To conduct intensive surveys on priority waterbodies in support of stream-use designations, wasteload allocation model calibration/verification, and other agency needs.
3. To store data in EPA's STORET system, a computerized water quality data base.
4. To coordinate ambient monitoring

activities with other agencies (EPA, Ohio River Valley Water Sanitation Commission, U.S. Geological Survey, U.S. Army Corps of Engineers, etc.).

The following sections discuss the various components of the monitoring program. For streams, this consists of fixed-station physicochemical and biological stream stations, reference reach sites, intensive surveys, citizens' water watch program, and volunteer stream sampling projects. The state's publicly owned lakes are monitored on a rotating basis (See Chapter 3).

Fixed-Station Ambient Monitoring Network

Physicochemical

The DOW's physicochemical monitoring network consisted of 44 stream stations located in all 13 major river basins (Table 1-1 and Figure 1-1). The Ohio River mainstem is assessed by ORSANCO, which has 11 stations on the 664 miles of the river bordering Kentucky. Samples were collected monthly at each station for the constituents listed in Table 1-2.

The DOW utilizes a single mid-channel grab sampling approach. Mid-channel grab samples have not been found to differ consistently from samples

Table 1-1. Fixed-Station Monitoring Network^a

Map No.	Station Name	River Mile	Road Location	Biological Sampling Performed 1994-1995^b
1	Tug Fork at Kermit	35.1	KY 40	-
2	Levisa Fork near Louisa	29.6	KY 644	-
3	Levisa Fork near Pikeville	114.6	KY 1426	-
4	Little Sandy River near Argillite	13.2	KY 1	X
5	Tygart's Creek near Load	28.1	KY 7	X
6	Kinniconick Creek near Tannery	10.4	KY 1149	X
7	Licking River at Claysville	78.2	US 62	-
8	N. Fork Licking River at Milford	6.9	KY 19	-
9	S. Fork Licking River at Morgan	11.7	KY 1054	-
10	Licking River at West Liberty	226.4	US 460	-
11	Little KY River near Bedford ^c	9.4	US 42	X
12	Kentucky River at Frankfort	66.4	St. Clair St. Bridge	X
13	Kentucky River at Camp Nelson	135.1	Old US 127	X
14	Eagle Creek at Glencoe	21.5	US 127	X
15	S. Elkhorn Creek near Midway	25.3	Moores Mill Rd. Bridge	X
16	Dix River near Danville	34.6	KY 52	X
17	Boone Creek at Hunt Club ^c	3.8	Grimes Mill Rd.	X
18	Red River at Clay City	21.6	KY 11/15	
18A	Red River at Sky Bridge	51.7	KY 715	X
19	Kentucky R. near Trapp	191.2	Red River Ferry Rd.	X
20	N. Fk Kentucky R. at Jackson	304.5 ^c	Old KY 30	X
21	M. Fk Kentucky R. at Tallega	8.3	KY 708	X
22	S. Fk Kentucky R. at Booneville	12.1	KY 28	X
23	Salt River at Shepherdsville	22.9	KY 61	-
24	Salt River at Glensboro	82.5	KY 53	-
25	Rolling Fk near Lebanon Junction ^d	12.3	KY 434	-

Table 1-1. (Continued)

Map No.	Station Name	River Mile	Road Location	Biological Sampling Performed 1994-1995 ^b
25A	Rolling Fk at New Haven ^c	38.8	US 31E	-
26	Beech Fork near Maud	48.1	KY 55	-
27	Pond Creek near Louisville	15.5	Manslick Rd. Bridge	-
28	Green River near Island	74.4	KY 85	X
29	Pond River near Sacramento	12.4	KY 85	X
30	Rough River near Dundee	62.5	Barrets Ford Bridge	X
31	Mud River near Gus	17.4	KY 949	X
32	Barren River at Bowling Green ^d	37.5	College St. Bridge	
32A	Barren River at L & D 1 ^c	14.5	Greencastle Rd	X
33	Green River at Munfordville	225.9	US 31W	X
34	Nolin River at White Mills	80.9	White Mills Bridge	X
35	Bacon Creek near Priceville	7.2	C. Avery Rd. Bridge	X
36	Tradewater River near Sullivan ^d	15.1	US 60/641	-
36A	Tradewater River near Olney ^c	72.7	KY 1220	X
37	Little River near Cadiz	24.4	KY 272	-
38	Cumberland R. at Turkey Neck ^d	393.7	KY 214 Ferry	-
39	S. Fk. Cumberland R. At Blue Heron	44.7	Old Rail Bridge	-
40	Rock Creek near Bell Farm	17.1	White Oak Bridge	-
41	Little South Fk Cumberland R near Ritner Ford	5.4	Freedom Church	-
42	Rockcastle River at Billows	24.4	Old KY 80	-
43	Horse Lick Creek near Lamero	7.5	Daugherty Rd. Ford	-
44	Cumberland R. at Cumberland Falls	562.3	KY 90	-
45	Cumberland River at Pineville ^d	654.4	Pine St. Bridge	-
46	Martins Fk near Cumberland Gap National Park	27.4	Off Hwy 987	-
47	Clarks River at Almo	53.5	Almo-Shiloh Rd. Bridge	-
48	Mayfield Creek nr Magee Springs	10.8	KY 121	-
49	Bayou de Chien near Clinton	15.1	US 51	-

^a Water quality samples collected monthly^b Stations not sampled in 1994-95 were sampled in 1992-93^c 49.7 miles upstream of confluence with S. Fk KY R.^d Water quality site only^e Biological site only

Figure 1-1

Fixed Station Monitoring Network

Stream Station Locations

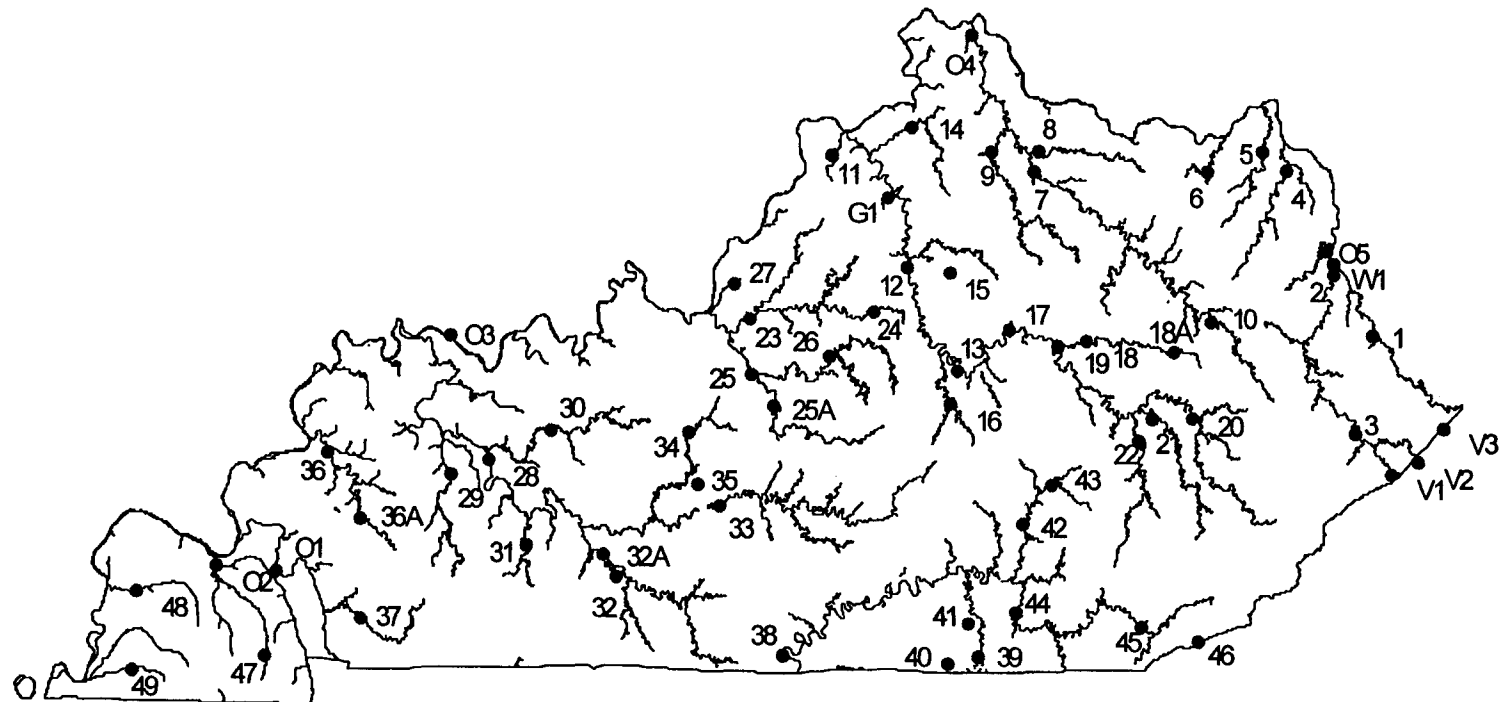


Table 1-2
Stream Fixed-Station Variable Coverage^a

<u>Field Data</u>	<u>Laboratory Data</u>
Water temp, °C (00010)	Alkalinity, mg/l (00410)
Specific conductance, uS/cm @ 25° C (00094)	Chloride, mg/l (00940)
Dissolved oxygen, mg/l (00300)	Sulfate, dissolved mg/l (00946)
pH, S.U. (00400)	Suspended solids, mg/l (00530)
Turbidity, N.T.U. (82078)	Total organic carbon mg/l (00680)
Flow, cfs (00061)	
 <u>Minerals, Total</u>	 <u>Metals, Total Recoverable</u>
Calcium, mg/l (00916)	Aluminum, ug/l (01105)
Magnesium, mg/l (00927)	Arsenic, ug/l (01002)
Potassium, mg/l (00937)	Barium, ug/l (01007)
Sodium, mg/l (00929)	Cadmium, ug/l (01027)
Hardness, mg/l (00900)	Chromium, ug/l (01034)
	Copper, ug/l (01042)
 <u>Bacteria</u>	Iron, ug/l (01045)
Fecal coliform, colonies per 100 ml (31616)	Lead, ug/l (01051)
	Manganese, ug/l (01055)
 <u>Nutrients</u>	Mercury, ug/l (071900)
Ammonia-nitrogen (00610)	Zinc, ug/l (01092)
Nitrite & nitrate-nitrogen (00630)	
Total Kjeldahl nitrogen, mg/l (00625)	
Total phosphorus, mg/l (00665)	

^a STORET codes are in parentheses

obtained by cross-sectionally integrated sampling. However, concentrations of suspended sediment and the total forms of some sediment-associated constituents, such as phosphorus, iron, and manganese, have been found to differ significantly, particularly under high-flow conditions. Field personnel follow guidelines in the Kentucky Standard Operating Procedure and Quality

Assurance Manual for the Ambient Surface Water Monitoring Program. This manual was initially released in 1988 and has been reviewed and modified as necessary. Sampling is performed at 19 stations by the program coordinator in the central office and by regional office personnel at the other 25 stations. Field meter audits are performed semi-annually at the regional offices by

the program coordinator. Data are edited for transcription errors before and after upload to STORET, EPA's national water quality data storage and retrieval system based in Research Triangle Park, North Carolina.

Excluding the mainstem of the Ohio River, water quality information generated by the fixed-station network was used to characterize 1,432 stream miles within the state. In addition to water quality information generated by its fixed-station network, the DOW used water quality data from a joint U.S. Geological Survey and Metropolitan Sewer District project at several sites in the Louisville metropolitan area and at ten sites throughout the state collected by the agencies indicated in Table 1-3.

The USGS discontinued water quality monitoring of the Kentucky River at the Lockport site in June 1995. However, the DOW began monitoring at this site in 1996.

Biological

Kentucky's biological monitoring program consists of a network of 49 stations located in 12 river basins (Table 1-1; Figure 1-1). The majority of the sites are at or near the physicochemical sampling sites. In 1993, the network was expanded to include stations on eight of the nine Kentucky Wild Rivers. Approximately one-fourth of the 49 sites are sampled each year, and sampling is done on a river basin approach. For instance, all stations in the Green River, Tygarts Creek, Little Sandy, and Tradewater river basins were sampled in

1994, and all stations in the Kentucky River basin were sampled in 1995. Data collected from these 25 stations were used to assess warmwater aquatic habitat (WAH) use support in 757.1 stream miles. The data were also used to determine potential sources of any use impairment, changes to existing water

Table 1-3. Water Quality Stations Maintained by Federal and Other State Agencies

<u>Ohio River Valley Water Sanitation Commission</u>		
	<u>River Mile No.</u>	<u>Map</u>
Cumberland River at Pinckneyville	16.0	O1
Tennessee R. at Paducah	5.0	O2
Green River near Sebree	41.3	O3
Licking River at Covington	4.5	O4
Big Sandy River near Louisa	20.5	O5
<u>US Geological Survey</u>		
Kentucky River at Lockport	31.0	G1
<u>Virginia Dept of Environmental Quality</u>		
Russell Fork near Elkhorn City	116.0	V1
Levisa Fork at state line	151.5	V2
Knox Creek at state line	7.6	V3
<u>West Virginia Dept. of Natural Resources</u>		
Tug Fork at Fort Gay, WV	0.1	W1

or habitat quality, background values against which future conditions can be compared, and problems with toxic and conventional pollutants, bacteriological contamination, and nuisance biological growth.

Algae. Algal samples were collected from each biological monitoring station using both artificial substrates (for biomass estimates) and natural substrates (for algal identification and community structure evaluation). The condition of the algal community was determined by a diatom bioassessment index (DBI), which includes the following metrics: total number of diatom species, diversity, pollution tolerance index, and relative abundance of sensitive species. Relative abundance of non-diatom algae and biomass (chlorophyll a and ash-free dry-weight) were used to arrive at the DBI.

Fish. Fish were collected for community structure evaluation at biological monitoring sites where sampling could be conducted. The condition of the fish community was determined by species richness, relative abundance, species composition, and the Index of Biotic Integrity (IBI). The IBI was used to assess biotic integrity directly by evaluation of 12 attributes, or metrics, of fish communities in streams. These community metrics include measurement of species richness and composition, trophic structure, and fish abundance and condition. The IBI was used to assign one of the following categories to a fish community: excellent, good, fair, poor, very poor, or no fish.

Macroinvertebrates. Macroinvertebrates

are collected from both artificial substrates and all available natural habitats. A macroinvertebrate bioassessment index (MBI) is calculated from several other indices, including, at a minimum: 1) taxa richness, 2) total number of individuals, 3) Hilsenhoff Biotic Index, and 4) Percent Community Similarity Index. Additional metrics are used depending on factors such as ecoregion and type of impact.

Intensive Surveys

Kentucky uses intensive surveys to evaluate site-specific water quality problems. Information developed from intensive surveys is essential in providing information to:

- Document the attainment/impairment of designated water uses.
- Verify and justify construction grants decisions.
- Address issues raised in petitions for water quality standards variances or use redesignations.
- Document water quality improvements and progress resulting from water pollution control efforts.
- Establish base-line biological data required for permit requirements and establishment of standards.

In 1994-1995, 17 intensive surveys were conducted on 106.1 miles of

streams. The locations, purposes, and conclusions of these surveys are summarized in Table A1-2. Methods are similar to those described above in the fixed-station biological monitoring section. These assessments were pooled with other information to arrive at the final use-support decisions.

Reference Reach Program

The DOW began a program in 1991 to gather physical, chemical, and biological data from the state's least impacted streams. The program looks at candidate waters as representative of geographical regions of the state known as ecoregions. This program defines the physical, chemical, and biological potentials for the streams of a particular ecoregion and allows a comparison with other streams in the same ecoregion. It also helps determine the potential legitimate uses of other streams in the same region. The data from this program will provide the basis for the development of narrative and numerical biocriteria for the various ecoregions of the Commonwealth. Data on chemical water quality, sediment quality, fish tissue residue, habitat condition, and biotic conditions are collected.

Fifty-five stream sites from seven proposed ecoregions were initially sampled in the spring and fall of 1992-93 under the Reference Reach Program. For this reporting period, 11 new sites were also sampled, resulting in a total of 689 miles that have been assessed for WAH use since 1992. Forty of these sites have been placed into the Reference Reach Program (Table 1-4; Figure 1-2).

Spring and fall collections will continue in order to increase the biological data base from undisturbed streams that can be used to compare with impacted streams. At the same time, program personnel will continue to develop and refine the necessary metrics used to evaluate the relationships between biotic communities and habitat conditions in streams across Kentucky.

Water Watch Volunteer Water Quality Monitoring Program

The DOW operates a volunteer services organization that conducts several key water quality improvement activities.

1. Water quality monitoring.
2. Shoreline cleanups and habitat improvement projects.
3. Community outreach and education projects.
4. Adult public participation and leadership training.

Water Quality Monitoring

The DOW has in place 270 water testing teams, each equipped with field kits that monitor dissolved oxygen, pH, temperature, nitrates, chlorides, and iron. Some teams have tests for detergents, phenols, or ortho-phosphate, depending on circumstances. These groups monitor local streams once each month and report their results to the DOW's Water Watch coordinator. Reports that indicate problem conditions can result in further

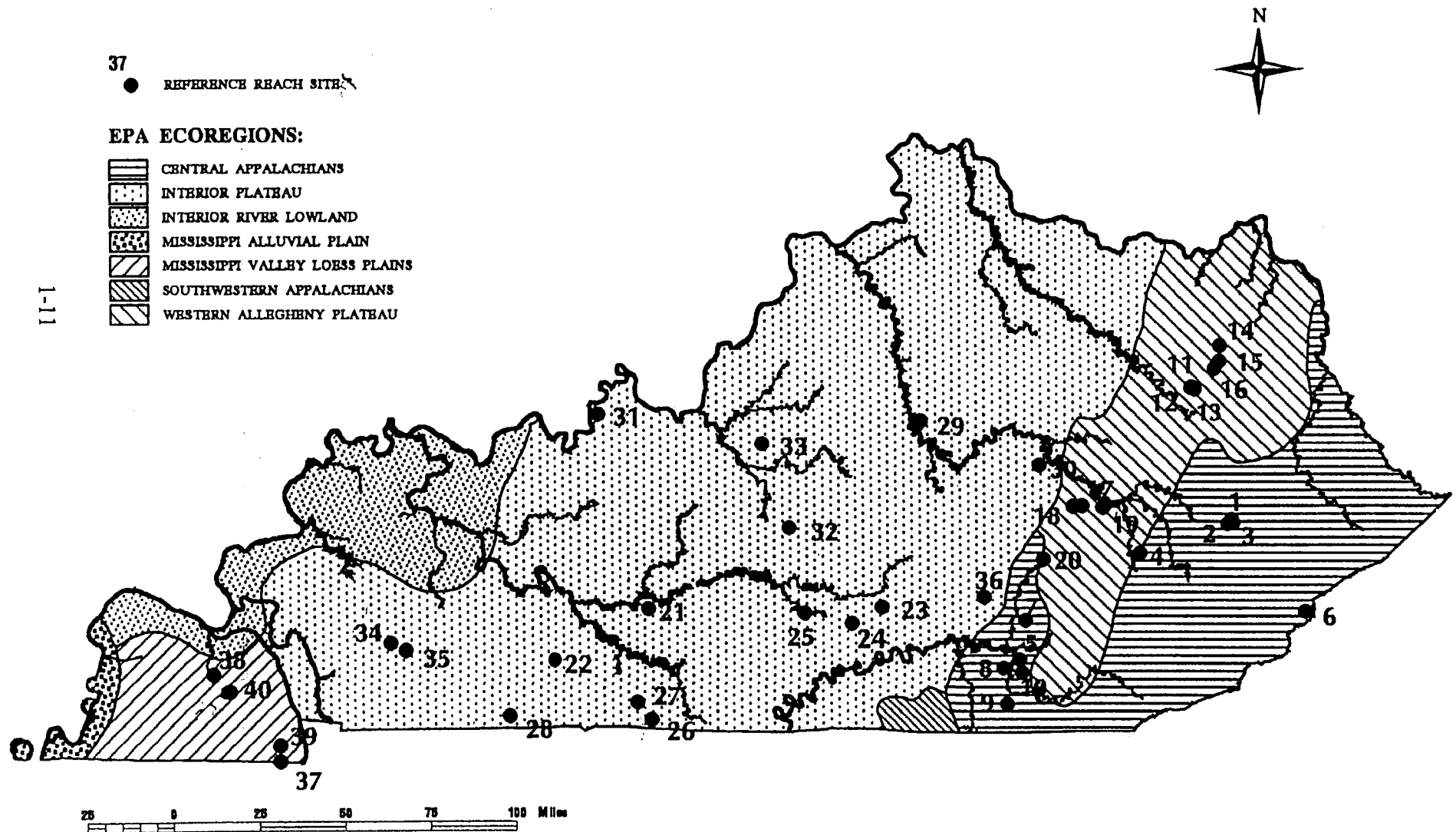
Table 1 - 4 . REFERENCE REACH SITES				
Map No.	Station Name	River Mile	County	Road Location
CENTRAL APPALACHIAN ECOREGION				
Kentucky River Basin				
1	Clemons Fork	0.5	Breathitt	Robinson Forest Rd.
2	Clemons Fork	3.0	Breathitt	Robinson Forest Rd.
3	Coles Fork	0.6	Breathitt	Robinson Forest Rd.
4	Right Fork Buffalo Creek	1.1	Owsley	Off Whoopflarea Rd.
Upper Cumberland River Basin				
5	Bark Camp Creek	2.5	Whitley	USFS Rd. 193
6	Bad Branch	0.2	Letcher	KY 932 Bridge
7	Cane Creek	7.0	Laurel	Off Middle Fork Rd.
8	Eagle Creek	3.0	McCreary	KY 896 Bridge
9	Marsh Creek	12.6	McCreary	KY 478 Bridge
10	South Fork Dog Slaughter Cr.	3.6	Whitley	USFS Rd. 195
WESTERN ALLEGHENY ECOREGION				
Licking River Basin				
11	Bucket Branch	0.1	Morgan	Leisure-Paragon Rd. Br.
12	Devils Fork	0.2	Morgan	KY 711 Bridge
13	North Fork	13.0	Morgan	Off Leisure-Paragon Rd.
Little Sandy River Basin				
14	Arabs Fork	0.1	Elliott	KY 1620 Bridge
15	Big Caney Creek	7.9	Elliott	Off Binion Ford Rd.
16	Laurel Creek	7.6	Elliott	Carter School Rd. Br.
Kentucky River Basin				
17	Station Camp Creek	19.0	Estill	Off KY 1209
18	South Fork Station Camp Cr.	5.3	Jackson	KY 89 Bridge
19	Sturgeon Creek	4.0	Lee	Off Sturgeon Creek Rd.
Upper Cumberland River Basin				
20	Horse Lick Creek	1.9	Jackson	Horse Lick Creek Rd.

Table 1-4 (Continued)

INTERIOR PLATEAU ECOREGION				
Green River Basin				
21	Beaverdam Creek	7.6	Edmonson	KY 101-259 Bridge
22	Gasper River	32.4	Logan	Bucksville Rd. Bridge
23	Goose Creek	5.6	Casey	Off Brock Rd.
24	Russell Creek	60.5	Adair	KY 80 Bridge
25	Russell Creek	25.6	Adair	Off KY 768
26	Trammel Fork	18.5	Allen	Red Hill Rd. Bridge
27	Trammel Fork	26.6	Allen	Concord Church Rd. Br.
Lower Cumberland River Basin				
28	Whippoorwill Creek	4.3	Logan	KY 2395 Bridge
Kentucky River Basin				
29	Clear Creek	4.1	Woodford	Hifner Mill Rd. Bridge
30	Muddy Creek	13.4	Madison	KY 52 Bridge
Ohio River Basin				
31	Yellowbank Creek	4.4	Breckinridge	Cart-Manning Rd.
Salt River Basin				
32	Salt Lick Creek	5.3	Marion	Off Salt Lick Rd.
33	Wilson Creek	12.2	Bullitt	Mt. Carmel Church Rd.
Tradewater River Basin				
34	Sandlick Creek	6.7	Christian	Mt. Carmel-Camp Cr. Rd.
35	Upper Tradewater River	128.9	Christian	T. Sparkman Rd. Bridge
Upper Cumberland River Basin				
36	Buck Creek	28.9	Pulaski	Off Bud Rainey Rd.
MISSISSIPPI VALLEY LOESS PLAINS ECOREGION				
Tennessee River Basin				
37	Blood River	15.1	Calloway	Grubbs Lane Rd. Bridge
38	Panther Creek	1.2	Graves	KY 2580 Bridge
39	Panther Creek	1.0	Calloway	KY 280 Bridge
40	Soldiers Creek	2.6	Marshall	KY 58 Bridge

Figure 1-2

REFERENCE REACH SITES



investigation by the Field Operations Branch or Ecological Support Section. Reports are also provided to local Soil and Water Conservation Districts, planning authorities, and municipal wastewater treatment authorities.

The DOW has placed 160 biological monitoring teams that conduct simple rapid bioassessments based on the Isaak Walton League protocols. Reports are submitted to the DOW as above. The DOW also consults with local organizations conducting stream quality monitoring providing technical assistance on quality-assured monitoring with contracted laboratory services.

Shoreline Cleanups

The DOW offers technical assistance and organizational support for stream cleanups and restoration projects. Seventy-eight clean-up projects were supported by the DOW during the two-year period covered by this report. Volunteers are recruited to conduct refuse removal, tree planting, bank stabilization, and habitat improvement projects.

Community Education Projects

The DOW recruits, trains, and supplies volunteers who conduct local water quality community education campaigns. These include booths, displays, classroom presentations, and stream walks. The DOW holds at least six workshops each year providing background and orientation for the volunteer educators. The DOW supplies the volunteers with printed materials,

audiovisual resources, display boards, use of the "Ollie Otter" clean water mascot, and field equipment to use in stream walks. An estimated 72,000 students and adults attended programs conducted by supported volunteer educators.

Leadership Training

The DOW sponsors training workshops for adult community group leadership on participation and involvement in community issues. This includes providing information on KPDES permitting, water quality standards review, policy development, and risk assessment. These workshops help establish a working relationship with environmental groups and neighborhood associations affected by agency permitting decisions.

Laboratory Support

The Division of Environmental Services was created in October 1982 to provide centralized laboratory services for environmental monitoring activities of the Department for Environmental Protection. Important programs requiring laboratory support include drinking water, ambient monitoring of lakes and streams, compliance monitoring of wastewater plants, ambient air monitoring, hazardous waste site investigations, and risk assessment activities. The division is organized according to functional areas in the laboratory and has an authorized staffing of 46 permanent employees. The laboratory is receiving approximately 5,000 samples annually from all

programs within the department. These samples require more than 34,000 tests and result in more than 300,000 parametric results. The average time to complete testing is less than 30 days.

The Division of Environmental Services operates within the guidelines of the Department for Environmental Protection Quality Assurance Program Plan. This plan was initially established in 1983 and has been reviewed and approved by both the USEPA/Region IV Quality Assurance Officer and the Regional Administrator.

The laboratory has developed and implemented a Standard Operating Procedures Manual for daily operations, including analytical testing, chain-of-custody, data reporting, and quality assurance.

Laboratory chain-of-custody procedures are designed to ensure that custody of samples is maintained after delivery to the laboratory. Access to the laboratory is limited to authorized personnel and is controlled by a computerized security system. Visitors are required to register in and out of the laboratory and are accompanied by laboratory staff during their visit.

The Division of Environmental Services utilizes applicable, approved analytical methods and procedures as specified in the Federal Register for the following programs:

- Safe Drinking Water Act (40CFR Part 141)

- National Pollutant Discharge Elimination System (40 CFR Part 136)
- Resource Conservation and Recovery Act (40 CFR Part 261)
- Clean Air Act (40 CFR Part 53)
- Clean Water Act (40 CFR Part 35 subpart G (Appendix A), 40 CFR Part 136).

The Division has been certified since 1984 by the U.S. Environmental Protection Agency as the State Principal Laboratory for all reportable Safe Drinking Water Act measurements with the exception of radionuclides, dioxin, asbestos, and microbiological testing. Radionuclide testing is provided via contract with Teledyne Isotopes Midwest Laboratory in Northbrook, Illinois. Microbiological testing for the department is provided by certified commercial laboratories in the state. In addition, the Water Resources Laboratory at Morehead State University has been designated as the State Principal Laboratory for Microbiological Drinking Water analyses.

The Division of Environmental Services is committed to participating in several performance evaluation studies to better substantiate laboratory capability and data quality. At present these include:

- USEPA Water Pollution

- Study - annually (plus follow-up study)
- USEPA Water Supply Study - annually (plus follow-up study)
- USEPA Air Pollution Studies for lead - semi-annually
- United States Geological Survey reference water samples - semi-annually
- Environmental Resource Associates - quarterly
- Resource Technology Corp. Laboratory Proficiency Testing Program - quarterly

Public Outreach

The Kentucky Legislature appropriated \$100,000 in the 1994-96 biennium for matching grants to 20 local governments to "promote community and local government partnerships in restoring, maintaining, and enhancing local and regional river resources and their accompanying watershed, stream and riparian areas." Known as the Community Rivers and Streams Grants, this program is administered by the Department of Local Government with technical support provided by the DOW.

Local watershed groups working for river resource protection are being established across Kentucky. These groups are concentrating on education, water quality monitoring, water quantity, and riparian habitat protection. Most of these watershed groups are members of the Kentucky Waterways Alliance, a state-wide coalition of local organizations and individual citizens who have come together to promote networking, project support, education, and advocacy. The

DOW is providing ongoing support for these local efforts.

An international Sister Rivers project, designed to promote partnerships of community-based river groups from different countries, was created by the DOW in 1993. The project seeks to pair citizens from watersheds in Kentucky with citizens from similar watersheds in other countries. Participants share common problems, ideas, and solutions to water-related issues.

Assessment Methodology

Aquatic Life and Primary Contact Recreation Use Support

The water quality and biological data described in the preceding pages were used to determine stream use support status. The data were categorized as "monitored" or "evaluated." Monitored data were derived from site specific ambient surveys and were generally no more than five years old. In some instances where watershed conditions remained mostly unchanged, monitored data collected prior to 1991 were still considered valid, and streams described by those data were categorized as monitored. Evaluated data were from other sources such as questionnaires to regional field personnel or from ambient surveys that were conducted more than five years ago. The criteria for assessing these data to determine use support are explained below.

In areas where both chemical and biological data were available, the biological data were generally the

determinant factor for establishing WAH use support status. This was especially true when copper, lead, or zinc criteria were contradicted by biological criteria. The DOW made this decision in recognition of the natural ability of surface waters to sequester metals, rendering them less available to aquatic life by reducing the toxic "dissolved" fraction.

Water Quality Data

Chemical data collected by the DOW, ORSANCO, and the USGS at fixed stations were evaluated according to EPA guidelines for the preparation of this report. Water quality data were entered into EPA's national storage and retrieval (STORET) database and compared to criteria as noted in Table 1-5. All of the criteria in the table, except fecal coliform, were used to assess Warmwater Aquatic Habitat (WAH) use support. The segment fully supported the WAH use when criteria for dissolved oxygen, un-ionized ammonia, temperature, and pH were not met in 10 percent or less of the samples collected from October 1993 through September 1995. Partial support was indicated if any one criterion for these parameters was not met 11-25 percent of the time. The segment was not supporting if any one of these criteria was not met more than 25 percent of the time.

Data for mercury, cadmium, copper, lead, and zinc were analyzed for violations of acute criteria listed in state water quality standards using three years of data (from October 1992 through September 1995). The segment fully

Table 1-5. Physical and Chemical Parameters and Criteria Used to Determine Use Support Status at Fixed Stations	
Parameter	Criterion ^a
Dissolved oxygen	4.0 mg/l
Temperature	30°C
pH	6 to 9 units
Un-ionized ammonia-N	0.05 mg/l
Mercury	2.4 ug/l
Cadmium	$e^{(1.128 \ln x - 3.828)}$ ^b
Copper	$e^{(.9422 \ln x - 1.464)}$ ^b
Lead	$e^{(1.273 \ln x - 1.460)}$ ^b
Zinc	$e^{(.8473 \ln x + .8604)}$ ^b
Fecal coliform bacteria	400 colonies/100 ml (May 1 thru Oct. 31)

^afrom KY Water Quality Standards

^bx = hardness in mg/l as CaCO₃

supported its use if all criteria were met at stations with quarterly or less frequent sampling or if only one violation occurred at stations with monthly sampling. Partial support was indicated if any one criterion was not met more than once but in less than 10 percent of the samples. The segment was not supporting if criteria were exceeded in greater than 10 percent of the samples. The assessment criteria are closely linked to the way state water quality criteria were developed. Aquatic life are considered to be protected if, on the average, the acute criteria are not exceeded more than once every three years. Fecal coliform and pH data were

used to indicate the degree of support for Primary Contact Recreation (swimming) use. The swimming use was fully supported if the criterion was not met in 10 percent or less of the measurements, partially supported if the criterion was not met in 11-25 percent of the measurements, and not supported if the criterion was not met more than 25 percent of the time. Streams with pH below 6.0 units were judged to not support swimming use.

Biological Data

Biological data for 1994-1995 were collected from 25 fixed monitoring network stations in six river basins, 51 reference reach sites, and 17 intensive surveys. Algae, macroinvertebrates, and fish were collected, and several community structure function metrics were analyzed for each group of organisms as described earlier in this chapter. These metrics were used to determine biotic integrity, water quality, and designated use support for each stream segment monitored (Table 1-6). Expectations for metric values are dependent upon stream size, ecoregion, and habitat quality and were applied accordingly. Bioassessments integrated data from each group of organisms, habitat data, selected physical and chemical parameters, and professional judgement of aquatic biologists.

The diatom bioassessment index classifies algal communities as excellent or good (supporting), fair (partially supporting), or poor (not supporting). For the macroinvertebrate evaluations, stream reaches were considered to fully

support the WAH use if information reflected no alterations in community structure or functional compositions for the available habitats and if habitat conditions were relatively undisturbed. A reach was considered partially supporting uses when information revealed that community structure was slightly altered, that functional feeding components were noticeably influenced, or if available habitats reflected some alterations and/or reductions. Reaches were considered not supporting uses if information reflected sustained alterations or deletions in community structure, taxa richness and functional feeding types, or if available habitats were severely reduced or eliminated. For fish, reaches with an IBI of excellent or good were considered to fully support uses. Reaches were assessed as partially supporting uses if they had an IBI of fair, while reaches were considered not supporting uses when the IBI category was poor, very poor, or no fish.

Intensive Survey Data

Seventeen intensive surveys to determine use support were conducted in the 1994-1995 biennium. Data also were used from surveys conducted between 1986 and 1993. The streams were assessed by evaluating principally the biological communities (refer to Table 1-6), and secondarily physicochemical, toxicity, and habitat data, watershed activities, direct observation, and professional judgement. To analyze biological data, the DOW uses a multi-component approach involving algae, macroinvertebrate, and fish communities. At least two of the three components

were used to assess water quality. Each component was analyzed using a variety of metrics that have proven sensitive to a wide variety of impacts. Stream mileages were grouped as supporting, supporting but threatened, partially supporting, or nonsupporting designated uses. Streams were considered to support designated uses if no or minor impacts to the biotic integrity, physical habitat, and water quality were observed. Supporting but threatened waters were those in which human activities occurring in the upstream drainage were extensive enough

to degrade water quality if pollution abatement measures were not taken. Streams were determined to be partially supporting when the data indicated either stressed biotic communities, minor violations of water quality criteria, or some physical impairment to aquatic habitats. Nonsupporting streams were those showing severe stress, such as sustained species deletions, trophic imbalances in the biotic communities, chronic violations of water quality criteria, and severely impaired aquatic habitats.

Table 1-6
Biological Criteria for Assessment of
Warmwater Aquatic Habitat (WAH) Use Support

	Fully Supporting	Partially Supporting	Not Supporting
Algae	Diatom Bioassessment Index (DBI) classification of excellent or good, biomass similar to reference/control or STORET mean.	DBI classification of fair, increased biomass (if nutrient enriched) of filamentous green algae.	DBI classification of poor, biomass very low (toxicity), or high (organic enrichment).
Macroinvertebrate	Macroinvertebrate Bioassessment Index (MBI) excellent or good, high EPT, sensitive species present.	MBI classification of fair, EPT lower than expected in relation to available habitat, reduction in RA of sensitive taxa. Some alterations of functional groups evident.	MBI classification of poor, EPT low, TNI of tolerant taxa very high. Most functional groups missing from community.
Fish	Index of Biotic Integrity (IBI) excellent or good, presence of rare, endangered or species of special concern.	IBI fair	IBI poor, very poor, or no fish.

EPT = Ephemeroptera, Plecoptera, Trichoptera, RA = Relative Abundance, TNI = Total Number of Individuals

Regional Office Visits

Visits were made to the ten DOW regional offices to discuss water quality issues with field inspectors. Often, problems that were not identified by other means became evident by these discussions. Also, potential causes and sources of the problems were often known by the inspectors, who spend much of their time in the field.

Discharge Monitoring Data

Discharge monitoring report (DMR) data, collected by KPDES permit holders, were accessed through DOWs permit compliance system (PCS) database. Depending on the relative sizes of the wastewater discharge and the receiving stream and the severity of permit violations, it was often possible to assess instream uses as threatened or impaired.

Kentucky Department of Fish and Wildlife Resources Data

Fisheries investigation reports prepared by the Kentucky Department of Fish and Wildlife Resources (KDFWR) were used to assess WAH use for several streams. The DOW also sent questionnaires to District Fisheries Biologists of the KDFWR. The responses consisted of both monitored and evaluated assessments. The biologists were requested to rate the waterbody fishery either good or poor. If poor, the biologist was asked to state the reason(s).

In this assessment of use support, only those questionnaire responses

indicating definite support or nonsupport were used. A waterbody was considered to fully support WAH use if:

- (1) the waterbody supported a good fishery based on presence of both young-of-year and adult sport fishes or served as a nursery for a larger waterbody and
- (2) water quality was judged good, with no repeated history of fish kills.

A waterbody did not support the WAH use if:

- (1) the waterbody fishery was poor, and
- (2) water quality was judged poor, with a history of recurrent fish kills.

Miles assessed by the district biologists' questionnaires are significantly fewer than were miles in the previous 305(b) report because of different methods of grouping streams into waterbodies. In the 1994 report, a waterbody consisted of several streams in a small watershed, and results were extrapolated from the primary stream in the waterbody to smaller streams in the waterbody. In the 1996 report, each stream is a distinct waterbody, and assessments were made on only those streams on which specific information was obtained.

The KDFWR conducts field surveys that identify streams capable of supporting a sustainable year-round trout

fishery. These data allow the DOW to classify streams as Coldwater Aquatic Habitat (CAH). Streams classified as CAH were considered to fully support the CAH use and were considered as monitored waters in the assessment.

Another source of data for the evaluated category was a list of streams recommended by the KDFWR as candidates for Outstanding Resource Waters. They were recommended because of their outstanding value as sport fishing streams. These streams were assessed as fully supporting warmwater aquatic habitat use if there were no data which conflicted with the assessment.

Other Data Sources

The Louisville and Jefferson County Metropolitan Sewer District, in cooperation with the USGS, has a monitoring program for streams in Jefferson County. Twenty-six stations are monitored for a variety of parameters including fecal coliform bacteria. Macroinvertebrate and fish collections are also made. The chemical and bacteriological data from 1989 to 1991 were used for this report, and they were considered to be monitored data in the assessments.

Field work conducted for the U.S. Fish and Wildlife Service, and verified by the Kentucky State Nature Preserves Commission (KSNPC) and KDFWR, identified streams in Kentucky that harbored the blackside dace, a federally threatened species of fish. This work was considered as monitored data. These

streams are automatically classified as Outstanding Resource Waters and were judged to fully support the WAH use.

Data from streams surveyed by the KSNPC for a special project to obtain background aquatic biota and water quality data in the oil shale region of the state was published in a 1984 report entitled Aquatic Biota and Water Quality and Quantity Survey of the Kentucky Oil Shale Region. Although more than ten years old, these data are still considered valid and were used in this report.

The Blaine Creek watershed has been monitored by the COE - Huntington District for several years in conjunction with the Yatesville Lake project. The COE macroinvertebrate and chemical data were utilized for this report.

U.S. Forest Service data were used for several streams in the Daniel Boone National Forest.

Fish Consumption Use Support

Fish consumption is a category that, in conjunction with aquatic life use, assesses attainment of the fishable goal of the Clean Water Act. Assessment of the fishable goal was separated into these two categories in 1992 because a fish consumption advisory does not preclude attainment of the aquatic life use and vice versa. Separating fish consumption and aquatic life uses gives a clearer picture of actual water quality conditions.

The following criteria were used to assess support for the fish consumption use:

- Fully Supporting: No fish advisories or bans in effect.
- Partially Supporting: "Restricted consumption" fish advisory or ban in effect for general population or a subpopulation that could be at potentially greater risk (e.g., pregnant women, children). Restricted consumption is defined as limits on the number of meals consumed per unit time for one or more fish species.
- Not Supporting: "No consumption" fish advisory or ban in effect for general population, or a subpopulation that could be at potentially greater risk, for one or more fish species; commercial fishing ban in effect.

Drinking Water Use Support

In 1986, amendments to the Safe Drinking Water Act (SDWA) required the U.S. Environmental Protection Agency (EPA) to set drinking water standards for 83 contaminants listed in the Act and an additional 25 contaminants every three years thereafter. EPA established a phased approach for introducing standards and requirements for testing for the first group of 83 contaminants.

Phase I - established maximum contaminant levels (MCLs) for a group of 8 volatile organic compounds.

Phase II - established MCLs for 17 pesticides, 8 inorganics, 10 volatile

organics, a new MCL for PCBs (polychlorinated biphenyls), and deleted the MCL for silver.

Phase III - set criteria for radionuclides.

Phase IV - set criteria for disinfection by-products and for disinfection for groundwater.

Phase V - set drinking water standards for 5 inorganics, 3 volatile organics, 9 pesticides, and 6 other organic contaminants.

Other rules: public notification, total coliform, surface water treatment, lead and copper.

Criteria were set for other contaminants, such as bacteria and secondary contaminants, in other rules outside this phased approach.

Phase II of EPA's schedule required monitoring and reporting for a large number of contaminants to be completed by 1995. Phase V established maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) for a number of the Phase II contaminants. (MCLs are enforceable standards considered feasible and safe. MCLGs are nonenforceable health goals that water systems should try to achieve.) Phase V also took advantage of the monitoring information provided through Phase II. These two phases required testing for the largest number of contaminants of the five phases.

Original cost estimates for each

water system to do Phase II/Phase V analyses ranged from \$10,000 to \$12,000 a year. Because of costs and the small number of laboratories certified to do the required tests (in 1993, there were no labs fully certified for these tests in Kentucky), the Department for Environmental Protection committed its analytical laboratory, the Division of Environmental Services, and the Division of Water (DOW) to carry out testing for systems that served 10,000 or fewer customers. Larger public and industrial/commercial systems were responsible for their own sampling and analysis.

The department conducted sample analyses and provided sampling containers, preservatives, supplies, and transportation costs involved in getting the samples to the lab. During 1993, DOW personnel spent 3,844 hours in various aspects of the sampling program. The project consumed almost all of the laboratory's capacity for analyzing organics. Organic analysis of other samples collected by the department were contracted to commercial laboratories.

Sampling for each system was done on a quarterly basis, and results from four consecutive quarters were used to determine compliance.

Sampling for the first of the small systems was accomplished in 1993. The department completed the testing for 168 systems that year without missing a quarter.

No sampling was done by the department in 1994 because the

laboratory moved its facilities to the new state central laboratory. Any interruption in the quarterly testing would have nullified results, and testing would have had to be repeated. However, approximately 70 facilities collected samples that were analyzed by recently certified commercial laboratories. Samples were collected at another 160 systems and analyzed by DES in 1995. The remaining 50 to 60 water systems, most very small, will be sampled in 1996.

Following the initial four quarters of sampling, a three-year monitoring period will be established. Waivers may be granted for individual systems for various contaminants based upon initial sampling results and vulnerability of the system to those contaminants.

Sampling and analysis of the state's smaller public drinking water systems has been a large, complex undertaking. However, the state will have a solid database for basing decisions about future monitoring to ensure the safety of drinking water for Kentuckians.

For purposes of assessing drinking water use, the Phase II/Phase V finished water results were compared to MCLs. Although not a quantitative measurement of ambient water quality, it highlights waters in which certain pollutants are high enough to exceed drinking water criteria even after conventional treatment by the drinking water plant. Lacking instream data, which historically has been scarce in Kentucky for drinking water constituents, EPA's 1996 305(b) report guidance recommends using the

finished water data for assessing drinking water use.

Use Support Summary

Overall use support was assessed by following EPA guidelines that define fully supporting as fully supporting of all uses for which data are available. If a segment supported one use, but did not support another, it was listed as not supporting. For instance, if a segment supported a WAH use but not a primary contact recreation use, it was listed as not supporting. A segment is listed as partially supporting if any assessed use fell into that category even if another use was fully supported. Many waterbodies were assessed for only one use because data were not available to assess other uses.

Table 1-7 shows that of the 9,219 miles assessed, 65 percent fully supported uses and 35 percent were impaired (partial or non-support) for one or more uses. This summary does not include ORSANCO's assessment of the mainstem of the Ohio River. ORSANCO reports that none of the 664 miles of the Ohio River bordering Kentucky fully supported swimming, fish consumption, or public water supply uses. For aquatic life use, 110 miles fully supported and 80 miles were not assessed. The Mississippi River, which forms 71 miles of Kentucky's western border, is assessed by Missouri.

Table 1-8 shows the summary results of individual use assessments. The use most impaired was swimming, with only 18 percent of waters assessed supporting

that use. In contrast, aquatic life use was fully supported in more than 75 percent, partially supported in 10 percent, and not supported in 14 percent of the assessed waters.

When individual use support is broken down by major river basin, it can be seen that some river basins had much higher percentages of uses being supported (Table 1-9). For example, aquatic life use was met in greater than 65 percent of the stream miles assessed in all river basins except the Big Sandy and the Tradewater. Ten river basins had 16 percent or less of their assessed stream miles supporting swimming use.

Causes of Use Nonsupport

Table 1-10 indicates the relative causes of use nonsupport. Stream segment lengths that either did not support or partially supported uses were combined to indicate the miles that were affected. Fecal coliform bacteria (pathogen indicators) were the greatest cause of use impairment and affected swimming use in 1,479 miles of streams and rivers. Siltation was the second greatest cause of use impairment, affecting aquatic life use in 897 miles of streams and rivers. Siltation affects the use by covering available habitat and reducing habitat for aquatic organisms. Other leading causes of use impairment were nutrients (549 miles), pH (511 miles, usually from acid mine drainage), and organic enrichment (431 miles). It should be noted that mileages of causes are not additive because more than one cause can affect the same reach of stream.

Table 1-7. Summary of Assessed^a Use Support (miles)			
Degree of Use Support	Assessment Basis		
	Evaluated	Monitored	Total
Fully Supporting	1765.5	4041.4	5806.9
Fully Supporting but Threatened	116.7	58.8	175.5
Partially Supporting	511.6	668.8	1180.4
Miles Not Supporting	859.6	1196.5	2056.1
TOTAL	3253.4	5965.5	9218.9

^aExcludes mainstems of Ohio and Mississippi rivers; refer to ORSANCO and Missouri 305(b) reports for assessments.

Table 1-8. Summary of Individual Use Support for Rivers and Streams					
Use	Supporting	Supporting but Threatened	Partially Supporting	Not Supporting	Total
Aquatic Life	6171 (72.8%)	208 (2.4%)	878 (10.4%)	1221 (14.4%)	8478
Fish Consumption	1579 (91.7)	7 (0.4%)	14 (0.8%)	123 (7.1)	1723
Swimming	323 (13.8%)	95 (4.1%)	891 (38.0%)	1033 (44.1%)	2342
Drinking Water Supply	1651 (100%)	0	0	0	1651

Sources of Use Nonsupport

Sources of use nonsupport were assessed under point and nonpoint categories and are listed in Table 1-11. Nonpoint sources as a whole affected nearly three times as many miles of streams as point sources. In some cases, both nonpoint and point sources contribute to use nonsupport in a particular surface water.

Resource extraction (1,185 miles), agricultural nonpoint sources (1,126 miles), and municipal and package plant sanitary wastewater point sources (777 miles) were the leading sources of use nonsupport. About 500 miles of the resource extraction source category are attributed to acid mine drainage from abandoned mine lands that pre-date the Surface Mining Control and Reclamation Act of 1977.

Another way to analyze the data would be to say that of the 9,219 total miles assessed, resource extraction and agriculture impacted 13 and 12 percent, respectively.

Again, the source mileages are not additive because more than one source can affect the same reach of stream.

Rivers and Streams Not Supporting Uses

Appendix A1-3 lists specific stream segments that did not fully support designated uses. Stream segments affected, type of assessment data (monitored or evaluated), and causes and sources of impairment are also listed. Stream use support is shown graphically

on the maps in the back cover.

Changes in Use Support: 1994 to 1996

Several waterbodies showed an improvement or a decline in water quality and a change in use support status since the 1994 report (Table 1-12). Many of the changes were in the swimming use category. The changes in swimming use support are probably most related to differing rainfall patterns between the years as fecal coliform contamination has been positively linked to rain events.

Trends in Water Quality

An assessment of water quality trends was performed at 31 ambient monitoring stations for the 1994 report and will be performed for the next 305(b) report when more than two years of additional data are available. The previous analysis showed decreasing trends for most of the 12 variables tested, including chloride and nutrients (nitrogen and phosphorus compounds). Iron exhibited an increasing trend at the majority of stations.

Public Health/Aquatic Life Impacts

Toxics

Although the biological monitoring program focuses on the protection of aquatic life from toxics and conventional pollutants, an underlying theme of aquatic life protection is subsequent public health protection. The DOW has played an increasing role in public health protection through assessing the need for fish consumption advisories based on

Table 1-9. Individual Use Support by Major River Basin (Miles)				
Basin	Supporting	Threatened	Partially Supporting	Not Supporting
Big Sandy				
Aquatic Life	344.5	22.1	206.7	111.6
Fish Consumption	107.6	7.0	0.0	0.0
Swimming	10.7	94.3	95.1	119.5
Drinking Water	128.5	0.0	0.0	0.0
Green River				
Aquatic Life	1185.9	5.9	98.6	248.3
Fish Consumption	387.9	0.0	0.0	116.2
Swimming	71.3	0.0	181.7	213.0
Drinking Water	418.5	0.0	0.0	0.0
Kentucky River				
Aquatic Life	970.9	19.7	242.6	267.9
Fish Consumption	456.1	0.0	0.0	0.0
Swimming	68.3	1.0	288.5	143.4
Drinking Water	413.2	0.0	0.0	0.0
Licking River				
Aquatic Life	646.0	8.8	42.8	96.5
Fish Consumption	75.4	0.0	0.0	0.0
Swimming	0.0	0.0	82.7	109.8
Drinking Water	337.0	0.0	0.0	0.0
Little Sandy				
Aquatic Life	213.6	0.0	0.0	11.9
Fish Consumption	43.7	0.0	0.0	0.0
Swimming	0.0	0.0	0.0	26.0
Drinking Water	22.2	0.0	0.0	0.0
Lower Cumberland				
Aquatic Life	543.8	65.1	79.7	0.0
Fish Consumption	134.9	0.0	0.0	0.0
Swimming	101.7	0.0	0.0	27.2
Drinking Water	209.1	0.0	0.0	0.0

Table 1-9 (CONT.)				
Basin	Supporting	Threatened	Partially Supporting	Not Supporting
Mississippi River				
Aquatic Life	218.4	1.7	11.9	7.0
Fish Consumption	5.3	0.0	0.0	0.0
Swimming	35.4	0.0	11.9	0.0
Drinking Water	0.0	0.0	0.0	0.0
Ohio River (minor tribs)				
Aquatic Life	538.3	13.9	22.0	113.0
Fish Consumption	0.0	0.0	0.0	6.5
Swimming	0.0	0.0	48.5	29.8
Drinking Water	16.1	0.0	0.0	0.0
Salt River				
Aquatic Life	484.3	23.4	60.0	114.6
Fish Consumption	70.9	0.0	13.8	0.0
Swimming	10.2	0.0	50.1	55.5
Drinking Water	35.8	0.0	0.0	0.0
Tennessee River				
Aquatic Life	176.4	15.4	21.5	14.3
Fish Consumption	84.3	0.0	0.0	0.0
Swimming	0.0	0.0	0.0	0.0
Drinking Water	0.0	0.0	0.0	0.0
Tradewater River				
Aquatic Life	68.3	0.0	26.3	92.9
Fish Consumption	0.0	0.0	0.0	0.0
Swimming	16.7	0.0	0.0	92.9
Drinking Water	5.1	0.0	0.0	0.0
Tygarts Creek				
Aquatic Life	88.9	0.0	0.0	2.1
Fish Consumption	89.1	0.0	0.0	0.0
Swimming	0.0	0.0	45.7	0.8
Drinking Water	11.3	0.0	0.0	0.0
Upper Cumberland				
Aquatic Life	691.8	31.6	66.2	140.6
Fish Consumption	123.5	0.0	0.0	0.0
Swimming	9.0	0.0	86.8	212.4
Drinking Water	54.1	0.0	0.0	0.0

Table 1-10 Causes of Use Nonsupport in Rivers and Streams		
Cause Category	Miles Affected	
	Major Impact	Moderate/ Minor Impact
Pathogen indicators	1300.5	178.8
Siltation	719.9	176.7
Organic enrichment/D.O.	281.4	149.9
Nutrients	237.7	311.5
pH	448.8	62.0
Metals	120.2	70.7
Salinity/TDS/ Chlorides	72.5	2.6
Priority organics	120.8	13.2
Unknown toxicity	30.0	3.6
Habitat alterations	71.0	159.4
Oil and grease	20.8	30.0
Suspended solids	25.0	197.9
Other	50.4	25.4

the concentrations of contaminants in fish tissue samples.

Fish Consumption Advisories

Six individual fish consumption advisories are currently in effect in Kentucky (Table 1-13). The advisories are based on contaminant residues exceeding the U.S. Food and Drug Administration (FDA) action levels in edible portions (fillets). PCBs are the contaminant of concern in five of the six advisories. Chlordane is also of concern in the Ohio River advisory,

Table. 1-11 Sources of Use Nonsupport in Rivers and Streams		
Source Category	Miles Affected	
	Major Impact	Moderate/ Minor Impact
Point Sources		
Municipal/Package Plants	383.2	394.0
Industrial	130.9	73.9
Combined sewer overflows	67.4	58.3
TOTAL	581.5	526.2
Nonpoint Sources		
Resource extraction	1036.8	148.6
Agriculture	640.5	485.8
Land disposal/septic tanks	389.0	373.7
Urban Runoff/Storm sewers	218.7	180.8
Hydro/Habitat modification	93.2	76.6
Silviculture	29.8	72.8
Construction/Development	26.4	51.9
Other	20.6	8.5
TOTAL	2455.5	1405.2
Unknown	82.1	10.9

and mercury is responsible for the sixth advisory. All advisories were jointly agreed upon and issued by the Kentucky Natural Resources and Environmental Protection Cabinet (NREPC), the Kentucky Department of Fish and Wildlife Resources (KDFWR), and the Cabinet for Health Services (formerly Human Resources). Operational protocols established in 1990 outline the roles of each agency

Table 1-12
Changes in Use Support at Ambient Monitoring Stations
1994 to 1996

	Non-or Partial Support to Full Support	Full Support to Non - or Partial Support
Waterbody		
Levisa Fork near Louisa	X	
Tygarts Creek near Load		X
Kinniconick Creek		X
Middle Fork Kentucky River at Tallegra		X
South Fork Kentucky River at Booneville		X
North Fork Kentucky River at Jackson		X
Red River at Clay City		X
Eagle Creek		X
North Fork Licking River at Lewisburg		X
Rockcastle River		X
Beech Fork near Maud	X	
Horse Lick Creek		X
Green River near Munfordville		X
Green River near Island		X
Barren River at Bowling Green		X
Little River	X	
Bacon Creek		X
Tradewater River near Sullivan	X	
Clarks River near Almo	X	
Mayfield Creek		X
Bayou de Chien		X

Table 1-13
Fish Consumption Advisory Summary

Stream	Pollutants	Source	Miles Covered	Date Established	Comments
Town Branch/Mud River (Logan, Butler, and Muhlenburg Counties)	PCBs	Dye-casting plant	71.5	October 1985	Cleanup in progress; monitoring continues. All species covered.
West Fork Drakes Creek (Simpson and Warren Counties)	PCBs	Adhesive plant	46.9	April 1985	Monitoring continues; levels in fish appear to be declining. All species covered.
Little Bayou Creek (McCracken County)	PCBs	Gaseous diffusion plant	6.5	April 1985	On-site clean-up in progress; monitoring continues; contamination appears limited to Little Bayou Creek. All species covered.
Ohio River (entire length of Kentucky border)	PCBs Chlordane	Urban runoff; no known point source discharge	663.9	June 1989	Channel catfish, carp, white bass, paddlefish, (and eggs) Monitoring continues.
West Kentucky Wildlife Management Area (McCracken Co)	Mercury	Unknown	5 Ponds	Nov. 1993	Largemouth bass
Green River Lake (Taylor and Adair counties)	PCBs	Gas pipeline compressor station	Entire Lake	Feb. 1994	Carp and channel catfish

in issuing fish consumption advisories. Additionally, ORSANCO and the states bordering the Ohio River coordinate the Ohio River advisory. In addition to the six advisories discussed above, Missouri has maintained an advisory on the 71 miles of the Mississippi River bordering Kentucky because of chlordane in fish tissue.

Conventional Pollutants

Chlorine, un-ionized ammonia, oxygen demanding substances, and pathogenic organisms such as bacteria and viruses are classed as conventional pollutants. These pollutants are a cause of concern because they are often responsible for fish kills or, like bacteria and viruses, can pose a threat to human health. Reports on fish kills, bacteriological evaluations of water quality, and beach closures are discussed below.

Fish Kill Incidents

Thirty-two fish-kill reports were received by KDFWR between January 1, 1994 and December 31, 1995. These kills involved 50 miles of streams. Oil and chemical spills were the most commonly identified causes of fish kills, but the causes of 21 fish-kill incidents were unknown. Table 1-14 summarizes the severity, causes, and locations of fish kills during the reporting period. A synopsis of fish-kill records from 1980-1993 is shown in Table 1-15.

Bacteriological Evaluations of Swimming Use

Fecal coliform bacteria are measured in water samples as indicators of the potential presence of other disease-causing bacteria. The most common illnesses experienced from swimming in waters contaminated by fecal coliform bacteria are gastroenteritis, ear infections, and skin infections (swimmers itch).

Several swimming advisories are in effect throughout Kentucky. These involve segments of several streams in the upper Cumberland River basin, 86 miles of the upper North Fork Kentucky River, and the lower Licking River and two tributary streams (see Appendix A1-4.). Also, the DOW and local governments have recommended that persons refrain from swimming in streams in and downstream of urban areas, especially after significant rainfall.

Bacteriological surveys were conducted during the 1994-1995 recreation seasons in the areas listed below:

- o North Fork Kentucky River
- o Upper Cumberland River Basin
- o Three-mile Creek/Lower Licking River/Banklick Creek
- o Fleming Creek
- o Laurel River Lake
- o Taylorsville Lake

Table 1-14
Fish Kill Summary

		1994	1995	Total
Severity:	Light(<100)	0	2	2
	Moderate (100-1,000)	4	5	9
	Major (> 1,000)	4	7	11
	Unknown	3	7	10
	Total	11	21	32
Cause:	Sewage (WWTP)	1	3	4
	Agricultural operation	1	1	2
	Mining or oil operation	0	1	1
	Oil or chemical spill	2	5	7
	Natural (low D.O., etc.)	2	1	3
	Herbicides	0	0	0
	Unknown	5	10	15
	Total	11	21	32
River Basin:	Big Sandy	0	0	0
	Licking	2	3	5
	Kentucky	2	10	12
	Salt	3	2	5
	Green	2	2	4
	Upper Cumberland	0	2	2
	Lower Cumberland	0	0	0
	Tennessee	1	1	2
	Ohio tributaries	1	0	1
	Total	11	21	32
Approximate number of stream miles		13.82	36.14	49.96
Estimated number of fish killed		56,859	115,557	172,306

Table 1-15
Fish Kill Synopsis, 1980-1995

Year	Number of Incidents	Number of Waterbodies	Stream Miles Affected	Surface Acres Affected	Number Fish Killed	Number Major Fish Kills*	Known Causes
1980	24	25	53.2	-	22,413	10	10
1981	26	30	74.3	-	81,266	7	10
1982	26	28	52.0	72.0	98,436	5	12
1983	36	41	51.3	7.0	76,187	8	19
1984	33	35	67.3	47.5	106,514	7	18
1985	29	27	86.9	4.5	59,499	5	9
1986	23	20	23.3	47.0	129,583	10	9
1987	30	32	58.3	200.0	229,583	10	14
1988	19	16	105.6	-	319,212	10	10
1989	23	23	47.8	9.0	222,330	9	11
1990	16	17	19.4	1.10	74,170	5	5
1991	17	18	36.9	25.0	60,038	7	7
1992	16	18	34.45	-	100,859	6	13
1993	5	5	4.31	-	60	0	5
1994	11	10	13.82	68	56,749	4	8
1995	21	20	36.14		115,557	7	14

* > 1000 fish killed

o Herrington Lake

A swimming advisory was issued in July 1990 for the entire length (162.6 miles) of the North Fork Kentucky River. Ten mainstem monitoring stations were used to monitor fecal coliform levels. As a result of compliance sampling inspections, fines totaling \$31,000 were issued to all permitted dischargers in the drainage that failed to meet KPDES permit limits for fecal coliform levels in their effluents. An improvement in water quality was found in May, 1993, and the swimming advisory was removed from approximately 76 miles in the lower portion of the drainage. However, numerous straight pipes (more than 1,200 in one county), which discharge untreated waste, were found in the upper portion of the drainage and are preventing the North Fork Kentucky River from attaining the primary contact recreational use.

Nonpoint source (Section 319) funds have been secured under the federal fiscal year 1994 grant to help implement a single on-site wastewater project for several homes at locations to be determined in the North Fork Kentucky River basin. These funds will also be used for education, enforcement, monitoring, and best management practices implementation.

An intensive survey was conducted in July and August 1993 in the upper Cumberland River basin. Water and wastewater samples for fecal coliform analysis were collected on two occasions at 21 mainstem stations and

43 tributary stations, as well as from the effluents of nine municipal wastewater treatment plant facilities (Williamsburg, Barbourville, Pineville, Loyall, Harlan, Cumberland, Benham, Lynch, and Evarts). Instream stations included five water plant intake locations (Williamsburg, East Knox, Harlan, Cumberland, and Cawood), four USGS gaging stations, and one drain pipe.

Four of nine municipal facilities tested did not meet KPDES permit limits for fecal coliform bacteria (Williamsburg, Pineville, Loyall, and Evarts). The effluents of Williamsburg, Pineville, and Evarts were indicative of raw sewage with little or no disinfection. Straight pipes, which discharge raw sewage, were also observed during the survey.

Fecal coliform data were collected again in 1994 and 1995 in the upper Cumberland basin. Sampling was performed at municipal wastewater treatment plants, package plants, and instream sites. This sampling resulted in the issuance of 25 Notices of Violation and 15 package plants referred to enforcement. Several municipalities, including Pineville, Harlan, and Benham, have either planned, begun, or brought on line new treatment facilities.

As a result of this intensive work in the Upper Cumberland River basin, swimming advisories were issued in 1994 and re-issued in 1995 for portions of the Cumberland River,

Martins Fork, Poor Fork, and Looney Creek and for the entire reaches of Catrons Creek, Clover Fork, and Straight Creek. (See Appendix A1-4).

The DOW sampled Three-Mile Creek, Banklick Creek, and the lower Licking River in Campbell and Kenton counties in 1991 and found they were polluted by fecal coliform bacteria. Advisories were sent to residents, creeks were posted, and notices were published in local newspapers about the risk of swimming in these waters. The DOW and the University of Kentucky, the latter with Clean Water Act Section 104(b) funds awarded to the DOW, continued to monitor these areas for CSO impacts. The data indicated the problems were persisting, and advisories have been re-issued in each subsequent year.

Herrington, Taylorsville, and Laurel River lakes were monitored for the presence of fecal coliform bacteria during the 1994 recreation season (May thru October) and found to fully support swimming and other recreational uses. With support from a Section 314 grant obtained by the Water Quality Branch from EPA, three sites were sampled at both Herrington and Taylorsville lakes: in the headwaters, at midlake, and near the dam. Laurel River Lake was sampled at ten sites on a monthly basis during the recreational season by personnel from the DOW's London Regional Office.

The results of sampling indicated that all three lakes support both

primary (i.e. swimming) and secondary (i.e. boating) contact recreational uses. With the exception of May 10 at Van Buren, all 26 samples collected from Taylorsville Lake were below the upper fecal coliform limit considered safe for swimming (400 fecal coliform colonies per 100 ml). The fecal coliform level at Van Buren on that day was most likely due to a period of wet weather that caused agricultural runoff from nonpoint sources in the headwater tributaries. A water sample collected on June 7 at Settlers Trace Marina was the only other sample above the geometric mean fecal coliform standard for primary contact recreational uses (200 colonies per 100 ml). Most of the remaining samples from Taylorsville Lake contained fecal coliform bacteria at very low levels. With the exception of a water sample collected at Sim's Midlake Boat Dock on July 12, all 26 water samples from Herrington Lake had fecal coliform levels less than 100 colonies per 100 ml. All monthly samples from Laurel River Lake were less than 400 colonies per 100 ml, usually much less.

Beach Closures

No state park beaches were closed during the 1994 or 1995 recreational seasons because of fecal coliform bacteria contamination. The Department of Parks built a swimming pool at Fort Boonesboro State Park that replaced the beach as a swimming area. The Department of Parks monitored the following state park

beaches:

Barren River Lake
Buckhorn Lake
General Butler
Grayson Lake
Green River Lake
Greenbo Lake
J.J. Audubon
Kentucky Dam Village
Lake Barkley
Lake Cumberland
Lake Malone
Pennyrile Forest
Rough River Dam

Public Health: Drinking Water

Of the more than 200 public water supply systems on surface waters

sampled in the Phase II/Phase V program in 1993-95, only 20 had MCL violations as a result of contaminants present in the source water. Some systems had more than one MCL violation. The majority of violations were for thallium (8) and antimony (7). There were also three violations of the MCL for ethylene dibromide, two for arsenic, and one each for nickel, barium, and selenium. Stream segments with MCL violations were initially assessed as partially supporting drinking water use, which resulted in 217 impaired stream miles. However, follow-up sampling at the surface water supplies indicated no further MCL violations, and 1,651 miles of surface waters were assessed as supporting the drinking water use.